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11.4 Advanced neutral alkali beam diagnostics for applications in fusion research

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Diagnosing the density profile at the edge of high temperature fusion plasmas by accelerated Lithium beam is a known technique since decades. By knowledge of the relevant atomic physics rate coefficients the plasma electron density profile can be calculated from the relatively calibrated light profile along the beam. Several additional possibilities have already been demonstrated: CXRS for ion temperature/flow, Zeeman polarimetry for edge plasma current therefore the Li-beam diagnostic offers a wealth of information at the plasma edge. The weakness of the method is the relatively faint light signal, background light and technical difficulties of the beam injector which usually seriously limit the applicability. In this talk we present systematic developments in alkali-beam diagnostics (Li, Na) both for the injector, observation system and detectors which resulted in strongly increased capabilities. Advanced systems have been built and microsecond scale density profile, turbulence and zonal flow measurement demonstrated. A novel edge current measurement technique has also been designed and demonstrated with potentially microsecond-scale time resolution. Additional possibilities of these advanced systems for spectral measurements (CXRS, various Zeeman schemes) are also outlined.

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